CLAIMS

1. An electromagnetic pump where a plunger including a magnetic body is provided so as to be capable of sliding inside a cylinder that is sealed at both end surfaces thereof by a pair of frames with spaces between the plunger and the end surfaces of the respective frames as pump chambers, air-core electromagnetic coils are disposed around an outer circumference of the cylinder, and a fluid is conveyed by passing a current through the electromagnetic coils to reciprocally move the plunger in an axial direction of the cylinder,

wherein intake valves and outflow valves that connect the pump chambers and the outside are provided inside regions of the frames at the end surfaces of the cylinder.

2. An electromagnetic pump according to Claim 1, wherein the frames are composed of non-magnetic bodies.

3. An electromagnetic pump according to Claim 1, wherein the plunger is formed by sandwiching a magnet that is magnetized in the axial direction of the cylinder between a pair of inner yokes.

4. An electromagnetic pump according to Claim 3, wherein the plunger includes a plurality of unitary plungers formed by sandwiching a magnet that is magnetized in the axial direction of the cylinder between a pair of inner yokes, the unitary plungers being connected in the axial direction via non-magnetic members.

5. An electromagnetic pump according to Claim 3, wherein flange portions that are shaped as short tubes and are in sliding contact with an inner surface of the cylinder at positions facing the electromagnetic coils are provided on edge portions of plate-like portions of the inner yokes that sandwich the magnet.

6. An electromagnetic pump according to Claim 4, wherein flange portions that are shaped as short tubes and are in sliding contact with an inner surface of the cylinder at positions facing the electromagnetic coils are provided on edge portions of plate-like portions of the inner yokes that sandwich the magnets.

7. An electromagnetic pump according to Claim 3, wherein an outer circumferential surface of the magnet sandwiched by the inner yokes is sealed by a sealing member made of a non-magnetic material.

8. An electromagnetic pump according to Claim 4, wherein an outer circumferential surface of each magnet sandwiched by the inner yokes is sealed by a sealing member made of a non-magnetic material.

9. An electromagnetic pump according to Claim 5, wherein an outer circumferential surface of the magnet sandwiched by the inner yokes is sealed by a sealing member made of a non-magnetic material.

10. An electromagnetic pump according to Claim 6, wherein an outer circumferential surface of each magnet sandwiched by the inner yokes is sealed by a sealing member made of a non-magnetic material.

11. An electromagnetic pump according to Claim 10, wherein an outer circumferential diameter of each sealing member is formed smaller than an outer circumferential diameter of the inner yokes.

12. An electromagnetic pump according to Claim 5, wherein the intake valves and the outflow valves are disposed inside concave parts formed inside the respective flange portions of the inner yokes.

13. An electromagnetic pump according to Claim 6, wherein the intake valves and the outflow valves are disposed inside concave parts formed inside the respective flange portions of the inner yokes.

14. An electromagnetic pump according to Claim 1, wherein an outer yolk composed of a soft magnetic material that surrounds the air-core electromagnetic coils is provided around an outer circumference of the air-core electromagnetic coils.

15. An electromagnetic pump according to Claim 1, wherein a length of the electromagnetic coils in the axial direction of the cylinder is longer than a movable range of the inner yolks inside the pump chamber.

16. An electromagnetic pump according to Claim 1, wherein dampers that ease shocks that occur when the plunger contacts the end surfaces of the frames are provided on the end surfaces of the frames.

17. An electromagnetic pump according to Claim 1, wherein dampers that ease shocks that occur when the plunger contacts the end surfaces of the frames are provided on surfaces of the plunger that face the end surfaces of the frames.

18. An electromagnetic pump according to Claim 1, wherein the intake channel of the pump chamber provided on one surface side of the plunger is connected to the intake channel of a pump chamber provided on another surface side of the plunger and the outflow channel of a pump chamber provided on the one surface side of the plunger is connected to the outflow channel of a pump chamber provided on the other surface side of the plunger.

19. An electromagnetic pump according to Claim 1, wherein the intake channel

provided on one surface side of the plunger is connected to the outflow channel provided on another surface side.

20. An electromagnetic pump according to Claim 1, wherein a sensor that detects a movement position of the plunger is provided and driving of the plunger is controlled based on a detection signal of the sensor.